REMARKS

Applicant notes the indication of claims 22 and 23 being allowed and claim 21 including allowable subject matter. Claim 21 has been amended so that it is now an independent claim including the limitations of the claims upon which it previously depended, i.e., claims 17, 19 and 20. In so amending claim 21, the language of claim 20 has not been included because the two "following" steps of claim 20 were essentially included in claim 21, as previously submitted, and the "processing" step of claim 20 was previously included in claim 19. Based on the foregoing, claim 21, as amended, should be considered allowed.

The specification has been amended to cure the informalities noted in the office action, as well as a few other informalities noted by attorney for applicants in reviewing the specification. As required by the office action, applicant submits (1) a new abstract in accordance with the requirements of the Patent and Trademark Office and (2) a new title indicative of the invention to which the claims are directed. As required by the office action, applicant submits a corrected version of Figure 3 including the stand defined by claims 22 and 23. Claims 19-21 have been amended to provide proper antecedents and thereby overcome the rejection based on 35 USC 112, paragraph 2. Claims 1, 2 and 17 have been amended to define the applicant's contribution to the art with greater specificity and claim 18 has been amended to include the limitations of claim 17 as originally written, with a clarifying amendment. Claims 24-44 have been added to provide applicant with the protection to which he is deemed entitled. The basis for the newly added claims is found in Figures 3-5 and the description thereof in the specification.

Claim 17 has been amended to obviate the rejection thereof as being anticipated by the admitted prior art. Claim 17 now requires only a first portion of the imaging detector to be exposed to the illuminated document during a first image capture operation to provide a first image data and

only a second portion of the imaging detector to be exposed to the illuminated document during a second image capture operation to provide second image data. In the admitted prior art, the first whole image is captured, stored and processed during operation 205 and then during operation 208 the second whole image is captured, stored and processed. Hence, the operation of the admitted prior art is completely contrary to the requirements of claim 17, as amended. Applicant, by exposing only a first portion of the imaging detector to the illuminated document during a first image capture operation and only a second portion of the imaging detector to the illuminated document during a second image capture operation, avoids the problems of the admitted prior art relating to requiring a camera to receive, process and store greater information than if only one image were obtained, as set forth in the last paragraph of the Background to the Invention portion of the application as filed.

Applicant traverses the rejection of claim 18 as being anticipated by the admitted prior art. Claim 18, as previously written, required the first portion of the imaging detector to not contain an image of the first light source in (i.e., during) the first image capture operation and the second portion of the imaging detector to not contain an image of the second light source in (i.e., during) the second image capture operation. The office action states that, in the admitted prior art, the first portion of the imaging detector does not contain a reflected image of the first light source and the second portion of the imaging detector does not contain a reflected image of the second light source after a transfer operation. Applicant does not agree such operation meets the "in" requirement of claim 18, as previously presented, because the words "in said first image capture operation" and "in said second image capture operation" of claim 18 are clearly associated with a specific time, i.e., the times when the image capture operations occur. However, to expedite prosecution applicant has amended claim 18 to change the word "in" to -- during --.

Claim 1 has been amended to obviate the rejection thereof as being obvious over applicant's admitted prior art. Claim 1 now requires the controller to be configured to collect an image of only a first portion of the illuminated document during the first image capture operation and to collect an image of only a second portion of the illuminated document during the second image capture operation. The admitted prior art has no disclosure of such a controller. Any controller the admitted prior art might include causes the first whole image to be captured, stored and processed during operation 205 and the second whole image to be captured, stored and processed during operation 208. Hence, any controller the admitted prior art might include has a structure completely contrary to the requirements of claim 1, as amended. The controller now defined by claim 1 avoids the problems of the admitted prior art relating to requiring the camera to receive, process and store greater information than if only one image were obtained, as set forth in the last paragraph of the Background to the Invention portion of the application as filed.

The obviousness rejection, based on the admitted prior art, of claims 3, 6, 7 and 11-16, all of which depend on claim 1, is overcome by the amendment to claim 1. The obviousness rejection, based on the admitted prior art, of claims 18 in 19, both of which depend on claim 17, is overcome by the amendment to claim 17.

Claim 2 has been amended so it (1) is an independent claim including the subject matter of claim 1 as originally submitted, and (2) includes a clarifying statement indicating the first portion of the imaging detector does not contain a reflected image of the first light source during the first image capture operation and the second portion of the imaging detector does not contain a reflected image of the second light source during the second image capture operation. Claim 2 now clearly distinguishes over the admitted prior art. As pointed out in the office action, in the admitted prior art the first portion of the imaging detector does not contain a reflected image of the first light

source after a transfer operation and the second portion of the imaging detector does not contain a reflected image of the second light source after a transfer operation. However, during the first and second image capture operations the admitted prior art does contain reflected images of the first and second light sources, respectively. As a result, the structure now defined by claim 2 avoids the problems of the admitted prior art relating to requiring a camera to receive, process and store greater information than if only one image were obtained, as set forth in the last paragraph of the Background to the Invention portion of the application as filed.

The rejection of claims 4, 8 and 9, all of which depend on claim 1, as being obvious as result of the admitted prior art and Hynecek U.S. patent 5,430,481 is overcome by the amendment to claim 1. Hynecek clearly does not provide a disclosure that cures the deficiency of the admitted prior art vis-à-vis claim 1 as amended. Consequently, claims 4, 8 and 9 are allowable with claim 1.

Applicant traverses the rejection of claim 10 as being obvious as result of the admitted prior art and Roberts, U.S. patent 5,452,004. The examiner admits the admitted prior art is deficient with regard to claim 10 because the admitted prior art fails to disclose the claim 10 feature requiring portions of the imaging detector to be configurable for independent use. The examiner relies on Roberts to disclose an imaging detector having the ability to create windows of portions of an array, wherein the windows can be individually read out and controlled. The examiner says it would have been obvious to one ordinary skill in the art to have modified the admitted prior art to include the foregoing features Roberts discloses.

Applicant cannot agree that it would have been obvious to one ordinary skill in the art to have modified the admitted prior art to include the claim 10 feature of portions of the imaging detector being configurable for independent use. The admitted prior art specifically states that the first whole image is captured, stored and processed and the second whole image is captured, stored

and processed. Modifying the admitted prior art based on Roberts would fly in the face of the specific "whole image" features of the admitted prior art. The admitted prior art relies on combining the first and second whole images to eliminate the glare spots associated with the flashes from the first and second light sources. The examiner, in combining Roberts with the admitted prior art, has cast about to find a feature of claim 10 the admitted prior art does not include. There is no motivation to combine Roberts with the admitted prior art, and as previously discussed, such a combination is contrary to the admitted prior art.

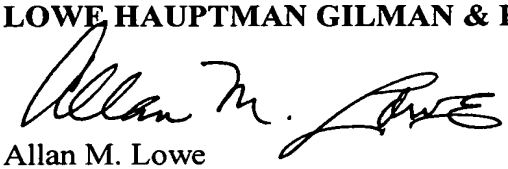
Newly added claims 24-44 define features not disclosed or rendered obvious by the art of record. For example, independent claims 24 and 30 include the requirement for detecting only first and second portions of reflected images at first and second sensing regions in response to an image being illuminated from first and second directions, and combining the detected first and second reflected image portions so the combined first and second reflected image portions are in substantially the same spatial relationship as the image, wherein the first and second directions and the first and second image sensing regions and the combining step are such that specular reflection from the image is not present in the combined image. Newly added independent claim 40 includes the requirement of first and second image sensing regions only on first and second sides of an optical axis, respectively. A controller enables only the first sensing region to be responsive to a reflected image adapted to be derived in response to a first optical source on the first side of the optical axis being activated and enables only the second sensing region to be responsive to a reflected image adapted to be derived in response to a second optical source on the second side of the optical axis being activated. The prior art of record does not disclose the foregoing features of new claims 24, 30 or 40. Since claims 25-29, 31-39 and 41-44 depend on independent claims 24, 30 or 40, as the case may be, these dependent claims are also allowable. Many the dependent

claims also include features not disclosed or made obvious by the art of record. For example, claims 25, 33-35 include limitations relating to the optical axis and the first and second image sensing regions.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 07-1337 and please credit any excess fees to such deposit account.

Respectfully submitted,

LOWE HAUPTMAN GILMAN & BERNER, LLP



Allan M. Lowe
Registration No. 19,641

Customer Number: 22429
1700 Diagonal Road, Suite 300
Alexandria, Virginia 22314
(703) 684-1111
(703) 518-5499 Facsimile
Date: September 7, 2004
AML/pjc

~~IMPROVEMENTS TO DIGITAL CAMERAS~~IMAGE DETECTOR METHOD AND APPARATUS INCLUDING POLURAL DETECTOR REGIONS AND IMAGE ILLUMINATORS

Field of the Invention

The present invention relates to digital camera, and particularly although not exclusively, to a digital camera configured to obtain an image of a document.

Background to the Invention

Digital cameras are known in the prior art and in their simplest form comprise a light, typically a flash light, a sensor containing image sensitive nodes and image storage nodes, a lens or series of lenses and a memory bank. The digital camera is known to be employed as an image capture device for capturing images of documents, and in operation is held in a fixed position over a document. The flash light is then triggered thus illuminating the document. The lens serves to focus the image onto the light sensitive nodes and the image is transferred to light storage nodes within the sensor. The final image is read out to a suitable memory bank where it is stored indefinitely awaiting a final process, for example, downloading onto a computer hard-drive or floppy disk.

However, a digital camera employed in this manner as a document image capture device has severe limitations due to the phenomena of specular reflections. Typically, most documents consist of a glossy material, which reflects light to a large extent. When the flashlight of the digital camera is triggered, high energy specular reflected light is incident on the light sensitive nodes of the sensor resulting, ultimately, in a glare spot within the final image, this glare spot effectively masking certain features of the document.

The problem of glare spots has been recognised in a different field (medical imaging - imaging of the cervix for detection of cervical cancer). US Patent No. 6088612 proposes a solution in which two light sources are used, and the glare-

affected parts of an image taken with one light source are replaced by the glare-free parts of the image taken with the other light source. However, obtaining two complete document images containing the two glare spots, requires the camera to receive, process and store twice as much information as would be required if only one image was obtained. This process for irradiating glare spots in this manner is therefore a relatively expensive process in terms of data storage capacity and processing time.

Summary of the Invention

According to first aspect of the present invention there is provided a digital camera configured to obtain an image of a document, said camera comprising:

first illumination means for illuminating said document in a first image capture operation of said camera;

second illumination means for illuminating said document in a second image capture operation of said camera;

image sensing means for capturing an image of said document from said first and second image capture operations, said sensing means arranged in first and second portions;

control means for controlling said sensing means, said control means being configured to collect an image of a first portion of said illuminated document during said first image capture operation said first image capture operation thereby resulting in a first image data, and said control means being configured to collect an image of a second portion of said illuminated document during said second image capture operation said second image capture operation thereby resulting in a second image data;

means for storing said first and second image data; and

means for processing said first and second image data so as to obtain a final image data of said document produced from said first and second image data.

Preferably said first portion of said sensing means and said second portion of said sensing means constitute part of an integrated image sensing unit, said unit further comprising a first portion of said storage means and a second portion of storage means.

A said first portion of said sensing means may be coupled to a portion of said storage means specifically allocated to said first sensing means portion.

Said camera may be configured to capture substantially half of said document image in said first image capture operation and capture substantially half of said document image in said second image capture operation.

Preferably the camera comprises at least one lens wherein illumination from said illuminated document passes through at least one lens prior to being received by said sensing means.

Suitably, the sensing means are positioned substantially above said at least one lens.

Preferably said sensing means comprises an array of light sensitive elements arranged for exposure to illumination from said documents;

said control means comprises an array of gating means, for gating charge collected by said array of light sensitive elements; and

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said storage means comprises an array of charge storage elements arranged to receive a plurality of charges from said array of light sensitive elements, via said gating means.

Said image sensing means may comprise:

an array of individual image sensing elements;

said control means may comprise an array of individual control elements; and

said storage means may comprise an array of individual storage elements, wherein

each said image sensing element has a corresponding respective said control element and a corresponding respective said storage element, the arrangement being that each said image sensing element accumulates charge in response to illumination, and said charge is controlled by said corresponding respective control element to be supplied to said corresponding respective storage element, or to be discharged from said image sensing element other than to said storage element.

Said portions of said sensing means may be configurable for use independently.

Said control means may be substantially integrated with said sensing means, said storage means, and said first and second illumination means.

Said camera preferably comprises means for enabling said camera to be maintained in a fixed position above said document.

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Preferably said control means may be configurable for use in producing a predetermined delay between said first image capture operation and said second image capture operation.

Said control means may be configurable for use in producing a said first illumination of said document and a said second illumination of said document consecutively, one after the other.

Preferably said sensing means is integrated directly to a storage unit or memory bank of the camera.

Said first illumination means and said second illumination means may be positioned diametrically opposite each other on a circle, and comprising at least one lens positioned at the centre of said circle.

Said camera may comprise means for attaching said camera to a support body, said support body being able to maintain said camera over said document in a substantially fixed position relative to a said document.

According to second aspect of the present invention there is provided a method of obtaining an image of a document using a digital camera, said method comprising the steps of:

illuminating the document in a first image capture operation of said camera;

illuminating the document in a second image capture operation of said camera;

using an image sensing means to capture an image of said document from said image capture operations;

during said image capture, controlling said image sensing means in accordance with the steps of:

exposing a first portion of said image sensing means to said illuminated document during a first image capture operation said first image capture operation thereby resulting in a first image data;

exposing a second portion of said sensing means to said illuminated document during a second image capture operation said second image capture operation thereby resulting in a second image data;

storing said first and second image data; and

processing said first and second image data so as to obtain a final image of said document produced from said first and second image data.

During said step of image capture, controlling said sensing means may comprise the steps of:

exposing a first portion and a second portion of the sensing means to said illuminated document during said first image capture operation said first image capture operation thereby resulting in a first image;

exposing said second portion and said third portion of said sensing means to said illuminated document during said second image capture operation said second image capture operation thereby resulting in a second image, said first and second image capture operations resulting in a third image;

storing said first, second and third images; and

processing said first and second images so as to obtain a final image of said document.

Said method may further comprise the steps of:

following said first image capture operation, transferring said first image from said first sensing means to a suitable first storage means; and

following said second image capture operation, transferring said second image from said second sensing means to a suitable second storage means; and

processing said first and second images so as to obtain a final image of said document.

Said method may further comprise the steps of:

following said first image capture operation, transferring said first image from said first portion of said sensing means to a suitable first storage means;

following said second image capture operation, transferring said second image from said second portion of said sensing means to a suitable second storage means;

transferring said third image from said third portion of said sensing means to a suitable third storage means; and

processing said first, second and third images so as to obtain a final image of said document.

The invention includes a digital imaging apparatus configured to obtain an image of a document, said imaging apparatus comprising a digital camera and a

stand adapted to hold said digital camera in a fixed orientation relative to said document, said digital camera comprising:

first illumination means for illuminating said document in a first image capture operation;

image sensing means for capturing an image of said document from said first image capture operation, and a second image capture operation, said sensing means arranged in first and second portions;

control means for controlling said sensing means, said control means being configured to collect an image of a first portion of said illuminated document during said first image capture operation, said first image capture operation thereby resulting in a first image data, and said control means being configured to collect an image of a second portion of said illuminated document during said second image capture operation, said second image capture operation thereby resulting in a second image data;

means for storing said first and second image data; and

means for processing said first and second image data so as to obtain a final image data of said document produced from said first and second image data;

said stand comprising:

a second illumination means for illuminating said document in said second image capture operation,

wherein said control means is arranged to activate said first and second illumination means for illumination of said first and second sensor portions.

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Brief Description of the Drawings

For a better understanding of the invention and to show how the same may be carried into effect, there will now be described by way of example only, specific embodiments, methods and processes according to the present invention with reference to the accompanying drawings in which:

Fig. 1 shows a digital camera suspended vertically above a document, the document resting on a flat surface;

Fig. 2 summarizes the steps of a process with which a digital camera, existing in the prior art, obtains a document image;

Fig. 3 illustrates a digital camera in operation according to a first specific implementation of the present invention, positioned vertically above a document placed on a flat surface.

Fig. 4 illustrates the sensor unit of the digital camera of Fig. 3 herein being divided into two regions.

Fig. 5 summarizes the steps required to obtain a document image using a digital camera containing a sensor unit divided into two regions according to a first specific method of the present invention;

Fig. 6 illustrates the sensor unit of the digital camera of Fig. 3 herein being divided into three regions; and

Fig. 7 summarizes the steps involved to obtain an image of a document using a digital camera containing a sensor unit divided into three regions.

Detailed Description of the Best Mode for Carrying Out the Invention

There will now be described by way of example the best mode contemplated by the inventors for carrying out the invention. In the following description numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent however, to one skilled in the art, that the present invention may be practiced without limitation to these specific details. In other instances, well known methods and structures have not been described in detail so as not to unnecessarily obscure the present invention.

Fig. 1 illustrates a prior art photography system 101 including digital camera positioned vertically above a document 104 resting on a flat surface ~~101~~103. The digital camera 102, comprises a lens 105 located substantially central on the lower face of the digital camera 102. Also present on the lower surface of the digital camera 102, placed diametrically opposite on a circle with the lens 105 at the center of the circle, is a first light source 106 and a second light source 107. The digital camera 102 further comprises a sensing and storing unit 108 positioned directly above the lens 105. Placed directly below the digital camera 102 is a document 104 residing on a flat surface 103. In operation, light source 106 is triggered thus illuminating the document 104, the reflected illumination from the illuminated document is ~~focussed~~focused by the lens onto the sensing and storing unit 108 within the digital camera 102. In so doing a glare spot is produced in this first image. The second light source 107 is then triggered illuminating the document a second time, this second reflected illumination from the illuminated document is then ~~focussed~~focused by the lens 105 onto the sensing and storage unit 108 within the digital camera 102. A second glare spot is then produced in this second image, this second glare spot being in a different position ~~to~~ from the first glare spot. The images resulting from the initial triggering of light source 106 and light source 107~~,~~ are then processed and combined, effectively eliminating the different glare spots contained in each first and second image captured, resulting in a final complete document image.

Fig. 2 illustrates a prior art process by which a document image is obtained using a digital camera already known to exist in the prior art. The process to obtain a document image begins with the activation of the camera in step 202, typically by a human operator, usually involving the depression of some form of button or switch. This method of activation results in a pulsing signal being sent to the first light source 106 whereby a flash of light from this first light source is emitted in step 203, whereby the document 104, positioned directly below the digital camera 102, is illuminated. Reflected light from the illuminated document is then ~~focussed~~focused by the lens 105 onto light sensitive nodes contained within the sensing and storing unit 108. In addition to the reflected light incident upon the light sensitive nodes, from the process of ~~lambertian~~ Lambertian reflection, additional reflected light is incident upon the light sensitive nodes. This additional light being termed specular reflection is 500 times brighter than the Lambertian ~~lambertian~~ reflections and as a result this specular reflection produces a glare spot at step 204 in one half of the document image. Upon capturing the reflected illumination from the document the image is then stored and processed at step 205. At step 206 the second light source 107 is triggered and a flash of light is emitted from this second light source. As with the initial flash of light in step 203, a second glare spot at step 207 is produced following this flash of light from the second source 206, due to the high intensity light generated from the phenomenon of specular reflection. In step 208 the second image containing the glare spot in the remaining half of the document image, is captured stored and processed. In step 209 the document image produced from the flash of light emitted from light source 106 containing glare spot 1, is combined with the image produced from the flash of light from light source 107 - this image containing glare spot 2. This process therefore involves the two-fold capture, two-fold storage and two-fold processing of the document images in order to eliminate the problem of glare spot formation inherent in flash light image capture, producing ultimately, a final complete document image generated through Lambertian ~~lambertian~~ reflection only, and hence devoid of glare spots.

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The process ends at step 211 after the camera operator decides not to proceed with further document image capture in the preceding step 210.

Fig. 3 illustrates a digital camera 301 placed directly above a document 302 according to a first specific implementation of the present invention. The digital camera 301 is maintained in a fixed position secured by a stand 300 vertically above the document ~~301~~302, the document residing on a suitably flat surface 304. The digital camera 301 comprises a lens 305 located on a lower face of the digital camera 301. Also positioned on the lower face of the digital camera are a first light source 306 and a second light source 307 placed diametrically opposite each other on a circle with the imaging lens 305 positioned at the center of the circle. The first light source 306 is positioned within or adjacent to a first reflective region 308 for reflecting light from the first light source, while the second light source 307 is located within or adjacent to a similar second reflective region 309. The digital camera further comprises a sensor unit positioned directly above the lens 305. The sensor unit is divided into first and second sensor regions 310 and 311, the first region 310 being situated closer to the first light source 306 and the second region 311 of the sensor unit being located closer to the second light source 307. The digital camera further comprises a storage or memory bank unit 312 located near to the sensing unit. In operation the digital camera is activated by a human operator or by other activation means. Upon activation, the first light source 306 generates a flash of light thus substantially illuminating a significant amount of the entire document. The reflected illumination from the document 302 comprises light due to Lambertian~~lambertian~~ reflection and light due to specular reflection~~,~~ both types of reflected light ~~passing~~ pass through the lens 305 and are incident upon the sensor unit. The sensor unit has an electronic shutter which divides the sensor unit into the two regions 310, 311, the two regions of the shutter being able to work independently of one another and can be triggered separately for capture of illumination from each half of the image of the document. The dividing line between the two halves of the sensor unit goes through the center of the image and is perpendicular to a line joining the two light

sources. The first and second regions 310 and 311 of the sensing unit~~,~~ are each configured to receive reflected light from a corresponding half of the entire document 303. The electronic shutter for the first region 310 of the sensor unit is activated~~,~~ so that charge on the first sensor region is captured~~,~~ in response to an image of the second region of the document while the second sensor region 311 remains in a 'closed' state so that charge variations on the second sensor region are not captured by the memory bank unit. Specular reflection produced from the flash of light from first light source 306 produces a glare spot 313 in one half of the document image. Reflected light from the Lambertian ~~lambertian~~ reflection of the second document region is captured by the sensing unit. First light source 306 is then triggered producing a flash of light thus substantially illuminating a significant amount of the entire document 302.

The states of the activated and non-activated regions of the sensing unit are then reversed thus permitting reflected light from the illuminated document 302 stemming from the triggering of the second light source 307, to be incident upon the exposed second region 311 of the sensing unit. Only Lambertian ~~lambertian~~ reflection is received by second sensor region 311, thus eradicating the glare spot 314, generated from the flash of light from the second light source 307, from the captured document image. Substantially half of the document image contained in first sensor region 310 and substantially half of the document image contained in second sensor region 311 can now be extracted from the sensor unit and processed. The first and second light sources 306 and 307 comprise any suitable type of light source. A particular advantage of using flash tubes for the light sources is that due to their short pulse nature, a very short exposure time may be used thus reducing the effects of external light sources.

Fig. 4 illustrates in more detail the sensing unit positioned above the lens 305 in the digital camera. The sensing unit 310, 311 is divided into the two distinct sensor regions 310, 311 the division being made perpendicular to a main plane of the lens 305. Each region of the sensing unit 403 comprises a parallel

array of nodes, positioned directly above the lens. The array of nodes comprises a plurality of light sensitive elements, for example photodiodes 404, the light sensitive elements being connected permanently to an array of corresponding respective first charge storage elements 406; a first array of control elements 405, for example transistors, which are connected to the first charge storage elements, and which are capable of charging (or discharging) the first charge storage elements 405 to a "reset" charge condition; a second array of storage elements 408 comprising capacitors each capable of storing charge accumulated by a corresponding respective first charge storage element; and an array of a plurality of second control ~~element~~ elements 407, each comprising for example a gating transistor, interposed between the corresponding respective first charge storage element 406 and second charge storage element 408. Each light sensitive node comprises a said light sensitive element, a said first and second control element, and a said first and second storage element. The individual second storage elements are connected to the storage memory unit 312 which stores the information contained in the individual charges stored in the second charge storage elements 408 as image data. In operation, reflected illumination from the illuminated document, positioned directly below the digital camera, passes through the lens 305 and is incident upon the array of light sensitive elements 404. Shuttering of the first and second regions of the sensing unit is achieved electronically by the first control elements 405. The shuttering operation works by resetting the charge on each first charge storage element by gating the element using a corresponding gating transistor 405~~,~~ to deplete the charge from the first charge storage element. This resets the light sensitive elements. The light sensitive elements continue to deplete charge in response to incident light. After a predetermined shutter period has expired, the second control element (gating transistor) 407 conducts the remaining charge on the first storage elements 406 which is transferred to the second charge storage elements 408. The charges in the second charge storage elements are read into the memory device 312 which stores image data.

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The period between reset of the first sensor region 310, and gating of the charge from the first storage elements 407 via the second control elements 406 to the second storage elements 408 is timed such that reset of the first storage elements 406 occurs immediately prior to activation of the first light source 306, and gating of the charge from the first storage elements 406 by the second control elements 407 to the second storage elements 408 occurs at a time after the flash of first light source 306. After reset, the photodiode light sensitive elements 404 deplete charge from the first charge storage elements. The period between reset of the first charge storage elements and gating of the charge from the first storage elements to the second storage elements may be optimized to a period around a time when the first light source illuminates, to avoid capture of light other than from reflection of the first light source on the document. Optimization of the period improves image quality.

Fig.5 illustrates the steps involved to obtain a document image using a digital camera comprising a sensing unit divided into the two distinct first and second regions 310 and 311. A first step 500 involves the activation of the camera, typically performed by the depression of a button or switch by a human operator or other activation means. At step 501 the first storage elements in first region 310 of the sensing unit are reset. Charge accumulates on the light sensitive elements 404. A flash of light is emitted from first light source 306, thus illuminating the document. The specular reflection produced from the first light source 306 via the document 303 passes through the lens 305 and is incident upon the first portion of the sensing unit which is in an 'open' condition. The flash of light stemming from first light source 306 upon reaching the document 303, produces Lambertian reflection which passes through the lens 305 and is incident upon the exposed light sensitive elements 404 of the first region 310 of the sensor unit. The image captured by the light sensitive elements 404 comprise substantially half of the document 303 this captured image stemming from the ~~Lambertion~~ Lambertian reflection, not the specular reflection and hence none of the light sensitive elements 404 are exposed to the glare spot 313 produced from

the light source 306, stemming from the specular reflection. At step 504 the charges on the first charge storage element 406 within the first region 310 are transferred via the second control transistors 407 to the second storage elements 408. At step 505 to 507 the steps 500 to 504 are repeated, employing the second light source 307, instead of the first light source 306 thus exposing the light sensitive elements 404, within the second region 311 of the sensor unit to the Lambertian reflection only, the second region of the sensor having light sensitive nodes in the 'open' condition. The specular reflection producing the glare spot 314 passes through the lens 305 and is incident upon the first region 310of light sensors ~~310~~ 404, which are now in the 'closed' condition. At step 508 the process is similar to the process described for step 504 involving the transfer of charge from the light sensitive elements 404 to the first storage elements 406. At step 509 the complete image of the document obtained from the combination of images from the first and second pass of the camera is read out from the sensor unit 403 into a suitable memory bank 312. The process ends at step 511 after the camera operator decides at step 510 not to proceed with the acquisition of an image of a further document.

Fig. 6 illustrates a second sensing unit divided into three distinct regions within a digital camera 601. The sensing units of Figs. 4 and Fig. 6 are very similar in that they both illustrate a sensing unit 601 positioned directly above a lens 602, the sensing unit 601 being connected to a storage unit or memory bank 603. In Fig. 6 the sensing unit 601 comprises a plurality of nodes arranged in a substantially parallel array, the array of nodes being substantially perpendicular to a plane of the lens 602. These nodes comprise a plurality of light sensitive elements 604 positioned near to the lens 602, a plurality of first charge storage elements 605 for storing charge; a plurality of first control means 606, for example transistors for re-setting the charge on first charge storage elements 604; a plurality of second charge storage elements 608 for storing charge transferred from the plurality of first charge storage elements 605; and a plurality of second control means 607, for example transistors, for transferring charge on

the first charge storage elements to the second charge storage elements. A distinct difference between the sensing unit of Fig. 6 compared to that of Fig. 4 is the multiplicity with which the second sensing unit of Fig. 6 is divided. In Fig. 6 the second sensing unit is divided into three distinct sensing regions 609, 610 and 611.

Fig. 7 illustrates the steps required to obtain an image of a document employing a digital camera comprising a sensing unit substantially divided into three distinct shuttered regions. At step 701 the camera is activated, typically by depression of an activation means such as a button or switch by a human operator. At step 702 the second and third sensing regions are reset, and the electronic shutters for those regions are opened, thus allowing charge collection in the second and third regions, while the first region of sensors remains 'closed' thus not accumulating charge. At step 703 a flash of light is emitted from a first light source thus illuminating the document, the specular reflection produced from the first light source via the document passes through the lens 603 and is incident upon the 'closed' first sensor region. Thus, through the geometrical arrangement of the sensor unit and the shutters, the glare spot in step 704 is omitted from the image of the document captured by the first sensor unit. Only Lambertian ~~lambertian~~ reflection, which passes through the lens 603 is incident upon the second and third sensor regions, thus the image captured by the second sensor region comprises an image of substantially half the document due to the geometrical position of the sensor unit, while the third sensor region receives more illumination with respect to the first or second regions from the entire illuminated document, however the glare spots are not captured by the second or third sensor regions. At step 705 the charge created in the second sensor region is transferred to the storage nodes within the second sensor region 605 via the second control transistors 607. At step 706, the first sensor region is reset, and the electronically shuttered second region 609 is closed. In step 707, a flash of light is then emitted from the light source thus illuminating the document for a second time, the specular reflection produced from the light source and the

document passes through the lens 603 and is incident upon the 'closed' second sensor region 607 thus preventing exposure of the second sensor region to the specularly reflected light and hence preventing the creation in the image of a glare spot in the second sensor region in step 708. Lambertian reflection resulting from the flash of light from the light source 307 passes through the lens 305 and is incident upon the exposed first and third sensor regions, this process affecting the charge on the first and third sets of light sensitive elements and eliminating a glare spot from the captured image in those regions at step 708. At step 709 the charge created in the first and third regions due to the reception largely of reflected Lambertian reflection, is transferred to the second storage elements via the second control transistors. At step 710 the images stored in the storage elements within the separate distinct first to third regions, are read-out to the storage unit 312. The process is terminated at step 712 once the operator of the digital camera has decided not to proceed with the acquisition of a subsequent document image in step 711.

In a further embodiment, the digital camera may be provided in a casing having a single flash unit, and being detachable from a stand unit, the stand unit maintaining the detachable digital camera in a fixed orientation above a document bed on which is placed a document. In this arrangement, the digital camera may be detached for use for other purposes, for example photographing scenery. When connected to the specially adapted stand, which contains a second flash unit, the combined camera and stand operates substantially as herein before described with reference to Fig. 3. In this arrangement, the lens and first flash unit are provided within a casing of the separate detachable digital camera, and the second lens unit is provided in a housing mounted to the fixed stand, such that when the detachable digital camera is connected into the stand, operation of the camera by a first illumination, followed by a second illumination resulting in first and second image capture operations as herein before described is achieved. A control mechanism for operation of the digital camera may be built into the digital camera itself, or built into the housing.

MARKED-UP VERSION SHOWING CHANGES